

AMENDMENTS TO THE SPECIFICATION

Please replace the Abstract with the following:

An apparatus for reducing clogs in a pneumatic material feed line, such as employed in abrasive waterjet machining systems, by providing an evenflow feed of material therethrough. The apparatus preferably includes a hollow housing defining a housing volume and having an inlet capable of connecting to an upstream portion of the pneumatic material feed line, an outlet capable of connecting to a downstream portion of the pneumatic material feed line, and an air vent located between the inlet and outlet for venting excess air pressure out from the housing volume. A diverter, i.e. an impingement object, is located at the inlet and in a path of incoming material from the upstream portion of the pneumatic material feed line, to break up clumps of ambient moisture-ridden material impinging on the diverter. And one or more filter screens is also preferably located in the housing volume to further break up clumps and provide filtering.

Please replace paragraph [0002] on page 2 with the following:

[0002] The present invention relates to pneumatic material delivery and feed methods and systems. More particularly, the present invention relates to an evenflow material distributor apparatus for preventing clogs in a breaking up bridged and agglomerated moisture-ridden abrasive material in a pneumatic material feed line such as used with and venting excess air pressure caused thereby,

so as to prevent clogs in the material feed line and provide an evenflow feed of material through to, for example, an abrasive waterjet machining systems, wherein the apparatus breaks clumps of abrasive particles in the feed line due to excessive moisture system.

Please replace paragraph [0004] on page 3 with the following:

[0004] Various types of pneumatic feed/delivery systems have been used to supply material through a feed line, and in particular feed abrasive particulate material to an abrasivejet. They typically involve a hopper and pneumatic source, such as an air compressor, at an upstream end of the feed system. And the hopper and pneumatic source are connected by a material feed line, such as a hose or pipe, to a second hopper at the abrasivejet. A known problem, however, often seen with this type of feed arrangement is the occurrence of clumping, bridging, and agglomeration of the abrasive particles in the delivery line caused by moisture and condensation from relative humidity. Excessive moisture has been known to develop especially in abrasive materials kept in storage for long periods of time. As a consequence, the bridging and clumping of the material in the delivery line can produce clog the delivery line until sufficient pressure builds in the line to clear the clog, thereby producing excessive/erratic air pressure and feed rates of the abrasive material to the mixing tube of the abrasivejet. This can disrupt the cutting action in waterjet machining and hamper productivity, as well as reduce edge quality of the machined part. While various measures have been proposed to dry the abrasive prior to

~~feeding it through the feed line (e.g. by baking-out the moisture using conveyor belts/inline drying system) complex and bulky subsystems are typically required which can significantly increase the cost of abrasivejet machining.~~

Please replace paragraph [0005] on page 4 with the following:

[0005] While various measures have been proposed to dry the abrasive prior to feeding it through the feed line (e.g. by baking-out the moisture using conveyor belts/inline drying system) complex and bulky subsystems are typically required which can significantly increase the cost of abrasivejet machining. A Thus a need still exists for a simple efficient, and cost-effective apparatus for preventing clogs in an abrasive feed line by breaking up the clumps of bridged or agglomerated abrasive particles and venting excess air caused thereby, to promote evenflow distribution of material through the feed line. Moreover, it would be beneficial to provide an apparatus which is easily adaptable for use with any commercial delivery line of with little or no modifications.

Please replace paragraph [0007] on page 4 with the following:

[0007] Another aspect of the present invention includes an evenflow material distribution apparatus for use in a pneumatic material feed line of an abrasive waterjet machining system, said pneumatic material feed line connecting a pneumatic source and an abrasive material supply at an upstream location to a hopper at a downstream location, comprising: a hollow housing defining a housing

volume and having an inlet adapted to connect to an upstream portion of the pneumatic material feed line, an outlet adapted to connect to a downstream portion of the pneumatic material feed line, and an air vent located between the inlet and outlet for venting excess air pressure out from the housing volume; a diverter located at the inlet and in a path of incoming abrasive material from the upstream portion of the pneumatic material feed line, for breaking up clumps of said abrasive material impinging upon said diverter; a first filter screen having a first pore size and located in the housing volume between the diverter and the outlet, for further breaking up clumps of said abrasive material impinging upon said first filter screen and filtering therethrough abrasive material sized less than or equal to the first pore size; and a second filter screen having a second pore size and located in the housing volume between the first filter screen and the outlet, for further breaking up clumps of said abrasive material impinging upon said second filter screen and filtering therethrough abrasive material sized less than or equal to the second pore size, wherein the diverter, first filter screen, and second filter screen operate to reduce clogs in the pneumatic material feed line due to bridging/clumping of the abrasive material.

Please insert the following new paragraph after paragraph [0011] on page 6:

Figure 3 is a schematic diagram of a material feed line shown employing the evenflow material distributor apparatus of the present invention and having a supplemental air injector 34 downstream of the evenflow material distributor apparatus.

Please replace paragraph [0012] on page 6 with the following:

[0012] The present invention is directed to an evenflow material distributor apparatus used inline with a material feed line of a pneumatic supply system to prevent clogs from forming in the feed line due to the presence of moisture-ridden abrasive clumps. The present invention is also directed to an improved pneumatic material feed line system for achieving the same purpose. The present invention operates not to correct the moisture levels in the abrasive, but rather to provide even distribution and flow of ambient moisture-ridden materials in the pneumatic supply system. In this manner, the evenflow material distributor apparatus allows the direct use of moisture-ridden abrasives in abrasivejet machining applications without the need for priming, drying, or otherwise preparing the material or the complex subsystems associated with such operations.

Please replace paragraph [0015] on page 7 with the following:

[0015] At the inlet 12 (i.e. adjacent to, near, or in the inlet), a diverter, shown as a dowel pin or peg 15, is placed in the path of incoming abrasive particles to operate as an impingement device, whereby clumps of abrasive particles are broken up by impinging upon and flowing around the diverter 15. The As such, the diverter may be characterized as an impingement object, and is shown centrally positioned at the inlet 12 and extending in a transverse direction to the incoming material flow. The

diverter 15 operates as a first line of clump impingement to break up the largest clumps of abrasive particles.

Please replace paragraph [0016] on page 8 with the following:

[0016] Second and third lines of clump impingement is provided by a first filter screen 16 and a second filter screen 17. In particular, the first filter screen 16 is shown located upstream of the second filter screen 17 and positioned between the diverter 15 and the second filter screen 17. And the second filter screen 17 is positioned between the first filter screen 16 and the outlet 13. Both the first and second filter screens 16, 17 preferably have a screen mesh structure, with each having a predetermined pore or hole size, e.g. 100 grit (holes/inch), chosen to suit a particular application and abrasive type. In a preferred embodiment, the first filter screen 16 has a larger pore size than the second filter screen 17 to collect successively smaller debris and break up successively smaller abrasive clumps. Moreover, the filter screens also operate to size the abrasive particles entering the abrasivejet nozzle. In this regard, the last, i.e. second, filter screen 17 has a hole size sufficiently small to size and pass only abrasive particles smaller than the abrasivejet nozzle to prevent obstructing therein. It is appreciated that while only two filter screens are described, additional filter screens may be employed for further clump-breaking, screening, and sizing. Furthermore, the filter screens may be integrally constructed into the housing 11, or not.

Please replace paragraph [0017] on page 9 with the following:

[0017] Figure 1 also shows an air vent 18 along a sidewall of the housing 11, and generally located downstream of the first filter screen 16 and upstream of the second filter screen 17. The air vent 18 is preferably a screen mesh having a pore size smaller than a single, unclumped abrasive particle to prevent particle leakage, while enabling the removal of excess air from the housing volume 14 and the feed line, and thereby preventing pressure build-up in the feed line due to clumping, bridging, and agglomeration. The removal of excess air pressure from the housing volume serves to correct for erratic air pressure increases which may be caused by the clumping, bridging, and agglomeration of material upstream of the apparatus. While the air vent in Figure 1 is shown flush with the housing sidewall, supplementary flow channels/conduits may be alternatively provided leading from the housing volume 14 to the air vent 18, such as with a T-shaped PVC pipe.

Please replace paragraph [0018] on page 9 with the following:

[0018] In Figure 2, the apparatus 10 is positioned to operate inline with the material feed line 20, shown as a hose, of the abrasivejet machining system. In particular, the inlet 12 of the apparatus 10 is connected to an upstream portion 21 of the feed line 20, and the outlet 13 is connected to a downstream portion 22 of the feed line. The upstream portion 21 in turn is connected to a first hopper 23 where the moisture-riden abrasive material (not shown) is loaded. A pneumatic source, such as a an air compressor 24 is operably connected to the feed line 20 such that abrasive material

entering from the first hopper 23 is forced into the feed line. ~~The apparatus 10 is shown preferably positioned at a substantially upstream location of the feed line 20 near the hopper 23 and pneumatic source 24, to break up clumps early in the feed line 20. And the downstream portion 22 in turn leads material exiting the apparatus 10 to a delivery location, such as a second hopper 27 of an abrasivejet machining arrangement.~~

Please insert the following new paragraph after paragraph [0018] on page 9:

As shown in Figure 2, the apparatus 10 is referably positioned at a substantially downstream location of the feed line 20 near the second hopper 27, such that clumped particles may be broken immediately prior to being released into the second hopper 27. In Figure 2, the apparatus 10 is also shown vertically connected to the upstream and downstream segments of the material feed line, with the inlet 12 and outlet 13 at opposite ends of the housing, such that passage of material through the hollow housing is assisted in part by gravity, i.e. a gravity feed. The gravity feed would enable continued passage of the material through the housing, despite the venting of excess air pressure out through the air vent as shown by arrows 33, and without requiring an additional air pressure source to feed the material through the remainder of the downstream portion 22.

Please replace paragraph [0019] on page 10 with the following:

[0019] ~~After traveling the length of the material feed line 20 with the assistance of the evenflow material distributor apparatus 10, abrasive material enters a second hopper 27 near the abrasive jet nozzle 29. Entry into the second hopper 27 is shown in the horizontal direction and may often be preceded by an elbow 25. Clumping may additionally occur through the elbow 25. As can be seen in Figures 2 and 3, however, a supplemental air injector, indicated at 26 in Figure 2 and at 34 in Figure 3, may also be utilized to further agitate the material for and through the remainder of the downstream portion 22. This is particularly beneficial where entry into the second hopper 27 is preceded by an elbow 25 in Figure 2 where clumping may recur therethrough. To address this problem, a small amount of air is introduced at the elbow using a supplemental air injector indicated by arrow 26 to agitate and accelerate material in an orthogonal direction to that of entry into the elbow.~~

~~Additionally, the As shown in Figure 3, a supplemental air injector 26 indicated by arrow 34, may also be utilized to agitate material exiting a horizontally-oriented apparatus 10 through the rest of the downstream portion 22. The air injector 34 is shown connected to the feed line using a Y-joint to provide direction injection of air pressure for agitation. Generally, an air injector may be located on the feed line 20 anywhere downstream of the evenflow material distributor apparatus 10 to supply additional pneumatic pressure in a direction of the feed and compensate for some of the pressure loss due to air venting at the housing 11.~~